

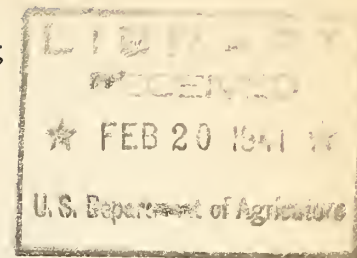
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UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Plant Industry
Bureau of Agricultural Chemistry and Engineering
and
Agricultural Marketing Service



ROLLER-GIN CONSTRUCTION, MAINTENANCE, AND OPERATION

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NECESSITY FOR ROLLER GINS ON CERTAIN COTTONS

Roller ginning is a method of separating lint cotton from the seed which was in use as long ago as the eighteenth century. The roller gin is probably an outgrowth of the ancient Hindu Churka gin, the first record of which goes back to about 800 B. C., although the two gins differ somewhat in principle of operation. The use of the roller gin is not always confined to the extra long cottons for in certain parts of the world it is still employed on short staple cotton. The process, however, is relatively slow as compared with saw ginning and because of that has never offered real competition in ginning upland cottons. In the United States roller ginning has been confined to the sea-island crop in the Southeast and to the American-Egyptian cotton in the Southwest. When sea-island production almost ceased during the early 1920's, there was no work for roller gins in these areas, and most of the equipment was either dismantled and stored away, junked, or sold for transfer to the irrigated Southwest, where American-Egyptian production was increasing.

1/ Acknowledgment is made to Charles A. Bennett, senior mechanical engineer, Bureau of Agricultural Chemistry and Engineering, and Francis L. Gerdes, cotton technologist, Agricultural Marketing Service, for supervision and suggestions, and to co-workers in these agencies for their assistance.

New efforts were put forth about 1930 to produce sea-island cotton again and after 1934 the crop increased, with 4,300 bales reported in 1938. The fair success with this crop in the former productive areas has caused its spread into several other States where trial plantings are being made. The so-called "comeback" of sea-island cotton has increased the need for roller ginning facilities in the Southeast because attempts to gin this type of cotton on saw gins have not been successful ^{2/}. Practically all these trial saw ginnings have been made in places outside the old established sea-island areas, because roller gin facilities were not available.

MECHANICAL PRINCIPLES OF ROLLER GINNING

The roller ginning process may be briefly defined as the mechanical separation of cotton fibers from their seeds by means of one or more rollers to which the fibers adhere while the seeds are impeded and struck off or pulled loose. Primitive roller gins merely pinched the fibers from the cotton seed by pulling them between rolling surfaces pressed together to give a gripping action. The size of the rollers prevented crushing or passage of the seed.

Modern roller gins employ a stationary knife bar in lieu of one roller and press it against a specially surfaced revolving cylinder so that fibers adhere to the face of the cylinder or roller and are thus readily drawn between it and the fixed knife until the seed is drawn up where it can be struck by a moving knifelike bar and the fiber thus detached from the surface of the seed.

Figure 1 depicts a sectional diagram of the salient parts of a single roller gin in which the roller cylinder, fixed knife, pusher bar, moving knife and other items are shown.

The roller, "R", and both cranks, "S" and "T", rotate clockwise. The moving knife, "F", pivoted from the arm, "G", and reciprocated by crank "S", moves up and down in an arc so that its upper edge overlaps the fixed knife, "D", by from $\frac{3}{8}$ to $\frac{3}{4}$ inches depending on the staple length of the cotton.

Seed cotton is fed into the trough, "U", from the apron, "W". The pusher or feeder bar, "O", slides the seed cotton along the seed grid "N" so that the fibers may be seized by the roller covering and drawn between the roller "R" and the fixed knife "D". Each stroke of the moving knife "F" pulls the seed loose from the fiber and moves it into a new position so that other fiber may be taken off by the roller. The seed grid, "N", allows only cleaned seed to fall through, and may be vibrated to make the action more effective.

^{2/} Martin, William J., Townsend, James S., and Walton, Thomas C., Sea-Island Cotton Quality and Ginning, U. S. Dept. of Agr. Multilithed Report, 1940.

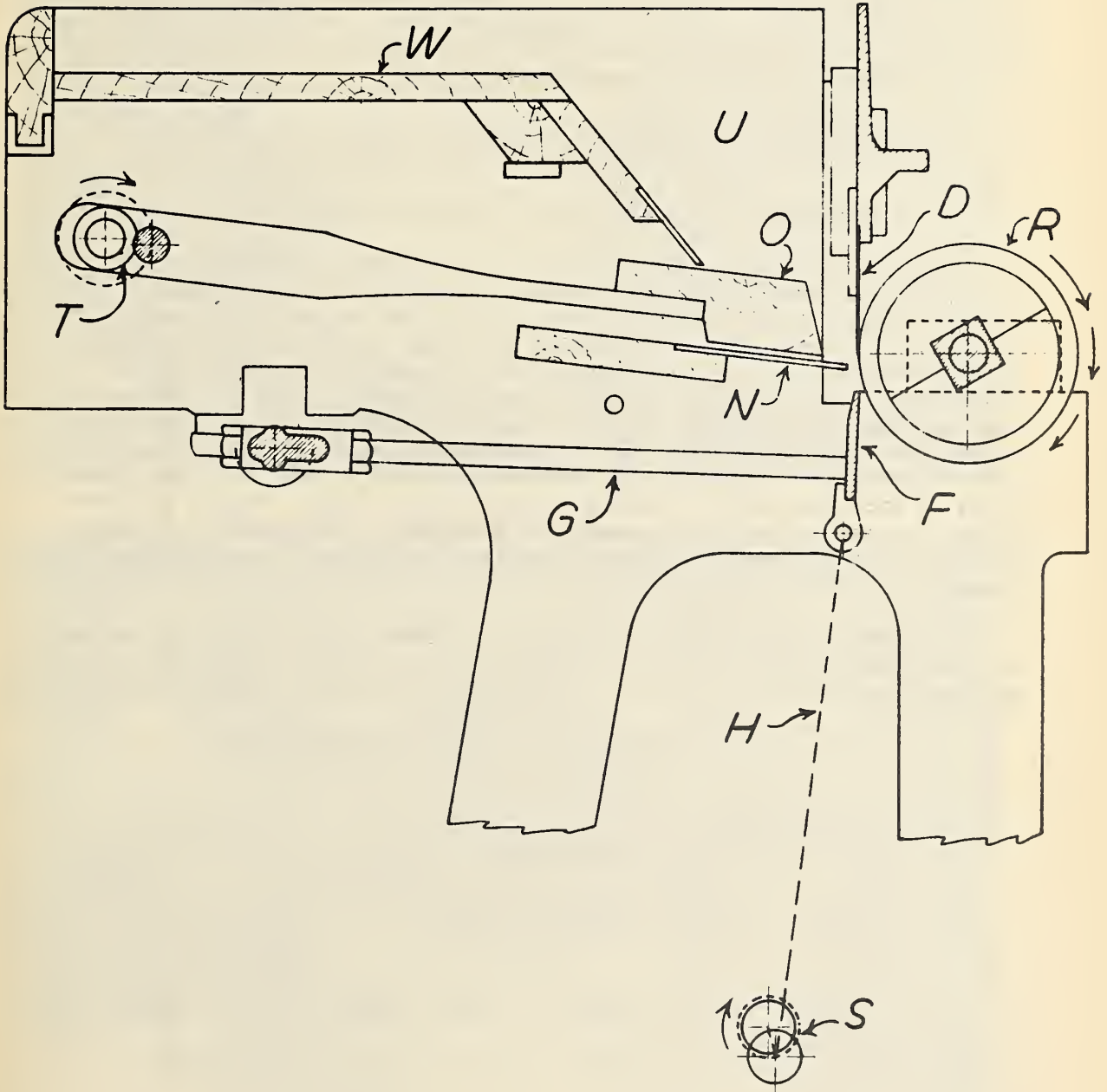


FIGURE 1. - Diagram of section of a single roller gin: D, fixed knife; F, moving knife; G, arm; H, crank leg; N, seed grid; O, feeder bar; R, roller; S and T, cranks; U, trough; and W, apron.

The peculiar gripping action or adherence of the cotton fibers to the roller-covering surface is an important element in the success of the roller-ginning process. Leather surfaces appear to be most effective and require a minimum pressure of the fixed knife, but other forms of covering ranging from coirboard to rubber packing have been used. Even metal cylinders have been experimented with. Final removal of the ginned fibers from the roller-gin cylinder presents problems which depend upon the nature of the covering, but stationary brushes or rotating doffers are now generally used. If the fibers are returned to the ginning point, jamming and chokages, commonly known as "back-lash", occur.

Roller ginning has not been mechanized to the same degree as that of saw ginning and consequently involves more manual labor per bale.

CHARACTERISTICS OF DIFFERENT DESIGNS OF ROLLER GINS

There are two principal types of roller gins in use today in the Sea-Island and American-Egyptian areas; namely, the Single Roller of 40 inches length and the Double Roller of 60 inches length, as shown in figure 2. At present there are about 30 roller-ginning plants operating in the Georgia-Florida area, usually having from 2 to 4 double-roller stands each, or 6 to 12 single roller stands. Most of the gins in this area are the double roller type but there is a tendency toward the single roller gin for new outfits. In the Southwest, the single-roller type is used exclusively in ginning the American-Egyptian cotton, and there were about 20 such ginneries operating in this area in 1939. Roller gin facilities for sea-island cotton were also available in at least one point in each of the States of Alabama, Arkansas, Louisiana, South Carolina, and Texas during the 1939 season.

As far as lint quality is concerned, there is no difference between the two types of roller gins provided both are correctly installed, properly adjusted, and are in good operating condition (table 1). There are individual

Table 1. - Comparative results from ginning sea-island
on two types of roller gins ^{1/}

Type of gin	Per 1500 pounds seed cotton				Elements of quality			
	Ginning:	Power	Energy	Bale	Commercial	Laboratory	data ^{3/}	
	time:	required	con-	wt.	Grade	Staple	Mean	Coef.
	2/	2/	sumption			length	length	of var.
	Min.	H.P.	K.W.H.	Lbs.	Index	1/32 inch	Inches	Percent
40" Single roller	291	1.4	5.1	437	2.6	51	1.270	32.7
60" Double roller	120	3.7	5.5	436	2.6	51	1.275	31.1

^{1/} Averages of nine series of tests, season 1939-40.

^{2/} Figures are net for gin stand.

^{3/} Averages of six series of tests, season 1939-40.

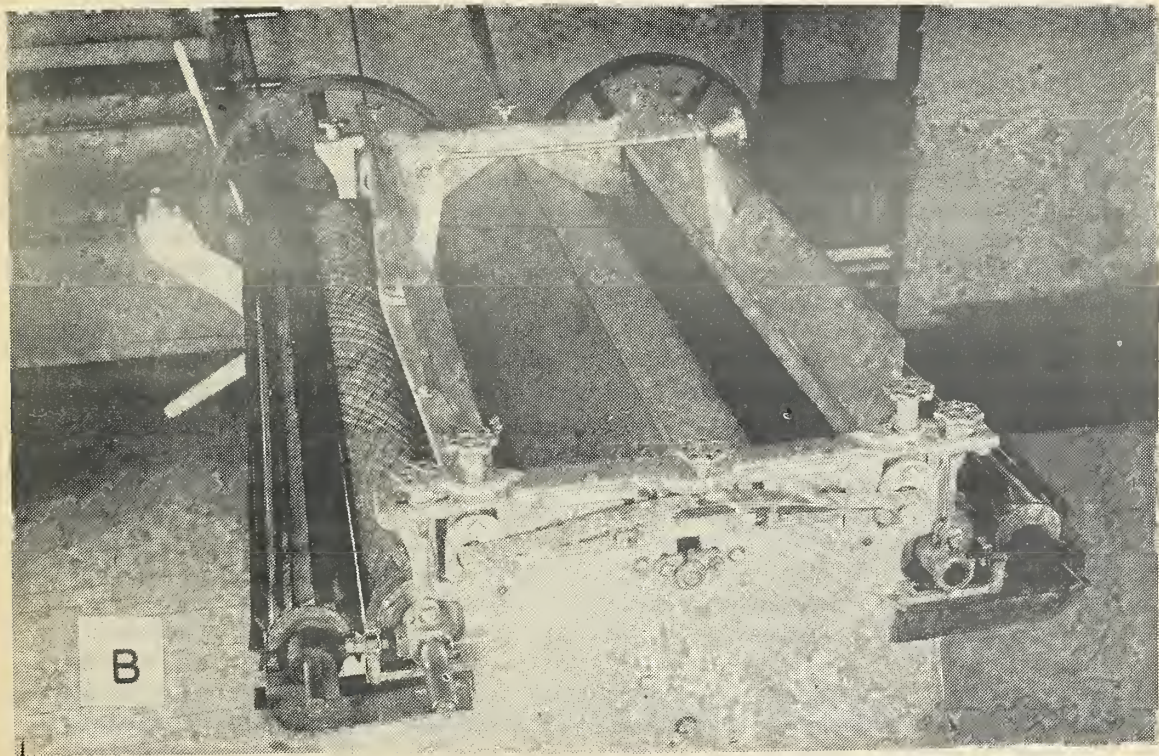
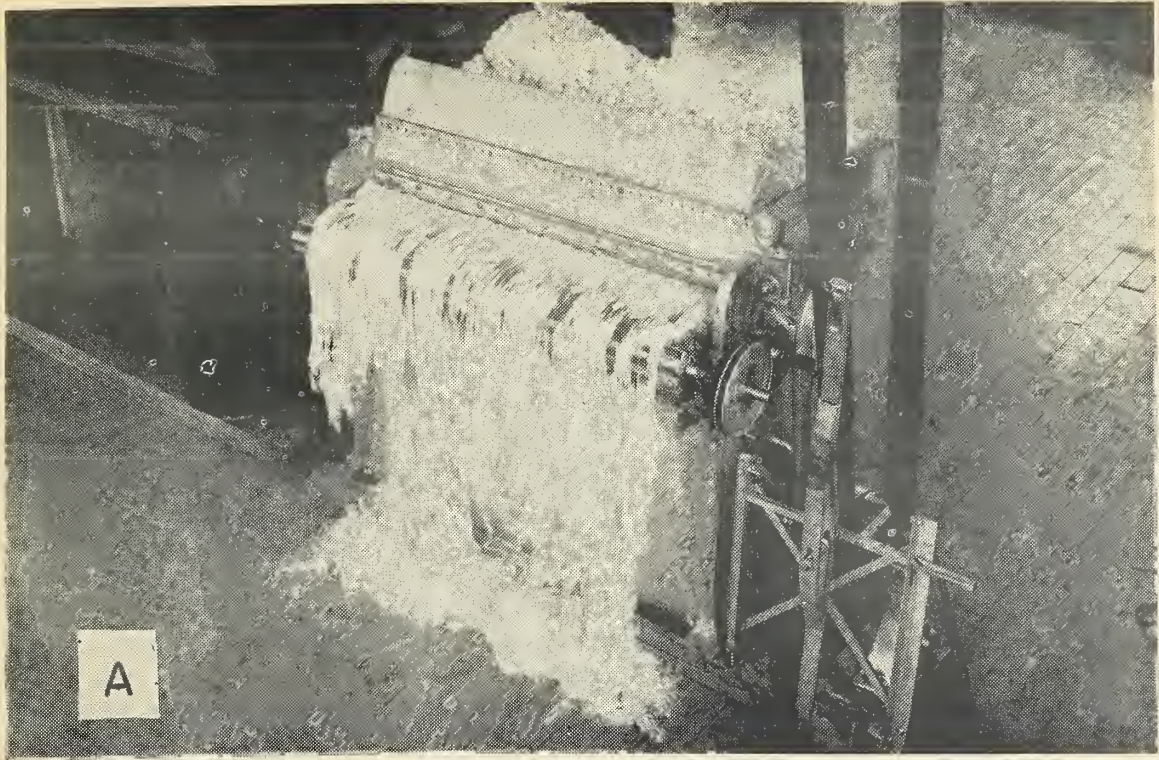


FIGURE 2.- Roller gins used in the laboratory experiments. (A) 40-inch single roller gin and (B) 60-inch double roller gin.

features about each of the gins that cause preferences on the part of ginners. The single-roller gin will usually stay in adjustment longer because it has fewer moving parts to get out of position. The double-roller gin is considerably harder to adjust, having six moving knives and two flexible fixed knives, the latter making it less susceptible to damage when backlash occurs. Backlash, in the case of roller gins, will occur when a wad of ginned lint goes around the roller and is wedged under the fixed knife, springing it out of position and into the path of the moving knife. When no provision is made to take up the shock, as in the case of the single-roller gin, the moving knife often strikes the fixed knife with a force sufficient to damage it.

From the standpoint of capacity, the double-roller gin does considerably more work for the floor space it occupies. Having two rollers, both longer than the single one on the other gin, one stand will gin a bale of cotton in about one-third the time required for the single-roller gin. This is about the same ratio shown by the respective roller surfaces of the two gins. Ginning capacity depends on the proper adjustment of the knives, the speeds of the roller and the crank, and the distribution of the seed cotton over the length of the roller. It has been customary to operate at crank speeds ranging from 600 to 900 r.p.m. in order to have as much capacity as possible. Although there is probably a point beyond which the relationship may not hold true, it was found that an increase of 15 percent in the crank speed gave a 14 percent better capacity, almost a direct ratio. Grade, staple, and other elements of quality as well as turnout, were not affected by this increase in crank-speed, showing that capacity increases were attained with no harmful effects on the ginned products.

PERFORMANCE OF GIN ROLLERS COVERED WITH DIFFERENT MATERIALS

The roller is a vital part of the gin and one requiring considerable attention. Its covering wears completely out with usage and repairing the roller consists of re-covering it in most cases. Walrus hide, which until recently was used extensively in this country, was thought to be unequalled for roller coverings. Research and experiments, however, have shown the possibility of obtaining a substitute. A packing made largely of rubber with cotton fabric, has been found to be very promising. It is much cheaper than the walrus hide, easier to obtain, and it appears to have many good qualities. The first types when tried for the entire covering did not prove very effective, but it was found that a covering of 25 percent packing and 75 percent walrus gave good results. This proportion of packing served to reduce the wear on the walrus by carrying most of the knife pressure, leaving the walrus with just enough pressure to pull the cotton over the roller. Recently a type of packing tried at the Department's cotton-ginning laboratory at Stoneville, Miss., has shown considerable promise when used as the complete covering. Results of the tests comparing this composition covering with the walrus covering are shown in table 2, and the rollers are illustrated in figure 5. The composition roller ginned slightly faster than the walrus, with only minor adverse effects on quality. The increased capacity and slight reduction in mean length are probably due to greater pressure on the roller which the composition covering carries. The wearing properties of the composition roller have not been determined but it can be said that from observation it appears about twice as durable.

Table 2.-Results of ginning sea-island cotton with different roller coverings

60-Inch Roller									
Roller covering			Capacity						
Type	Amount required	Estimated cost ^{1/}	per minute	Bale weight	Mean length	Coef. of Var.	Grade	Staple	
	Pounds	Dollars	Pounds of lint	Lbs.	Inches	Percent	Index	1/32 inch	
Composition	27	21.60	1.91	435	1.261	33.1	2.7	50	
Walrus	35	52.50	1.75	434	1.271	32.8	2.5	50	

40-Inch Roller									
Composition	18	14.40	1.46	436	1.221	34.9	2.7	50	
Walrus	23	34.50	1.33	433	1.259	36.1	2.6	51	

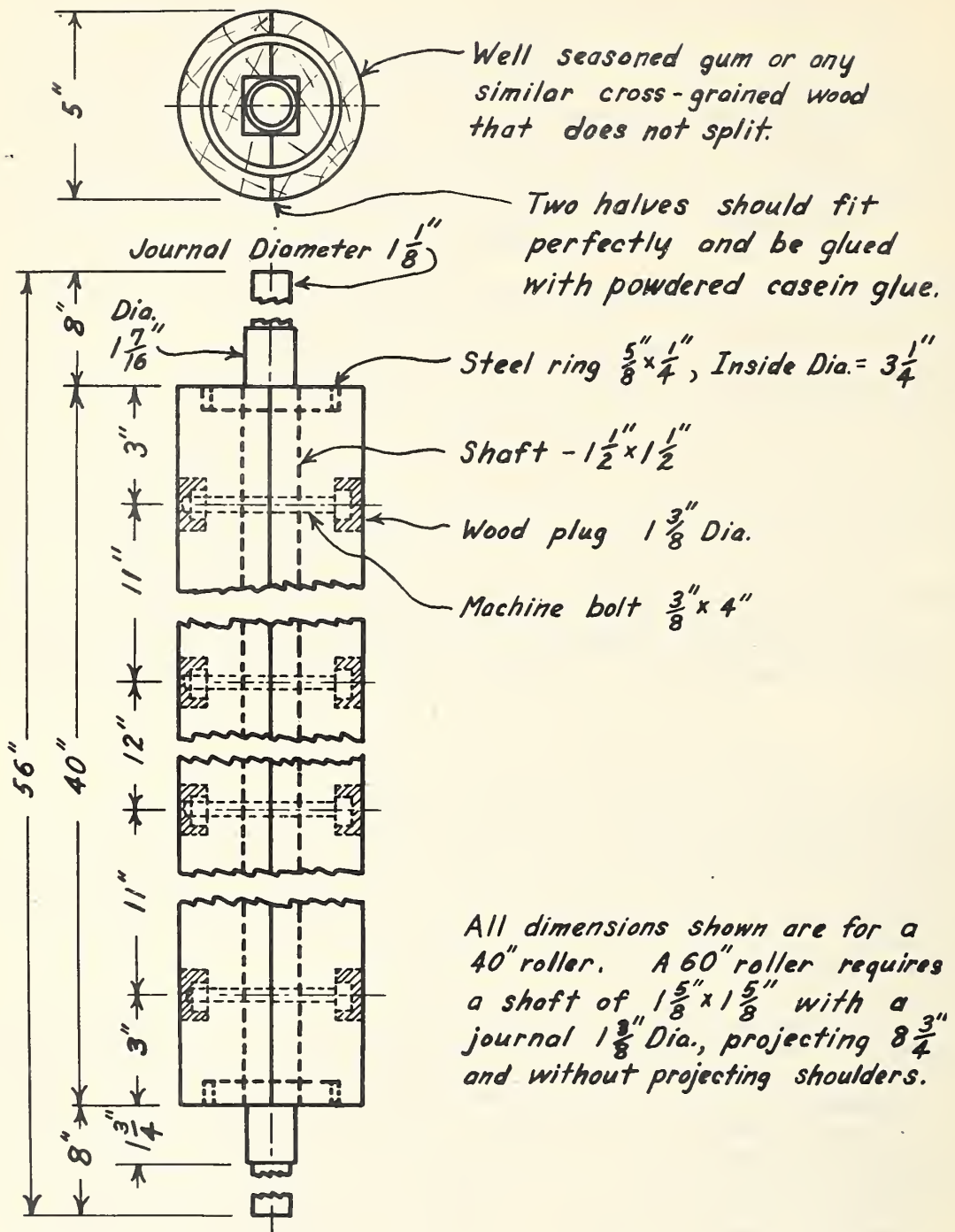
^{1/} Based on quotations at end of 1939-40 season, Walrus @ \$1.50 per pound and the composition No. 40 Spider Tucks Packing @ 80 cents per pound.

ROLLER CONSTRUCTION, COVERING, AND MAINTENANCE

The assembly of the parts which make up a gin roller, exclusive of the covering, is shown in figure 3. The square steel shaft is embedded in the wooden halves, and securely bolted, as shown. To prevent the ends of the cylinder halves from spreading apart, a shrink ring may be "gained in" at the ends in a manner that will not interfere with attachment of the covering. The holes where the bolts are sunk are plugged with wood after the cylinder is turned to size prior to covering. Three stages of roller construction are shown in figure 4.

When a gin roller becomes noticeably worn it must be re-covered. The old worn covering is first removed, in whole or in part, preferably by turning it off in a lathe. Care should be taken not to cut into the wooden cylinder any more than absolutely necessary as this will make the roller smaller. As a matter of fact, it is good practice to leave a small thickness of the previous walrus on the turned roller, if it is still securely attached. The procedure of putting on the new covering is the same for both walrus rollers and mixtures of walrus and rubber, and the following description applies to a combination of 75 percent walrus and 25 percent rubber, or a half-and-half combination.

The strips of packing, which usually come 5/8 x 5/8, must be split so as to make pieces 5/16 x 5/8-inch. The strips of walrus must be first dressed with a jack plane on both sides. One end of the strip is tacked to a bench with the hair side up. This side is hard and bumpy and should



CONSTRUCTION OF ROLLER

SCALE: 3" = 1'

-5-40

FIGURE 3.-Drawing of parts and assembly of a gin roller, exclusive of the covering.

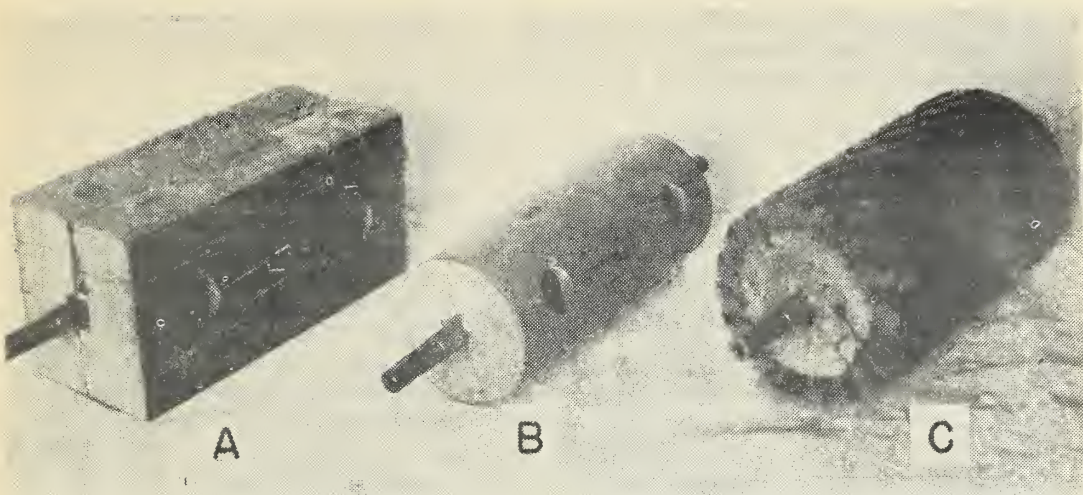


FIGURE 4.-Stages in construction of a 16-inch roller; (A) shaft and block assembly, (B) core after turning down in lathe (holes yet to be plugged) and (C) after covering with walrus hide.

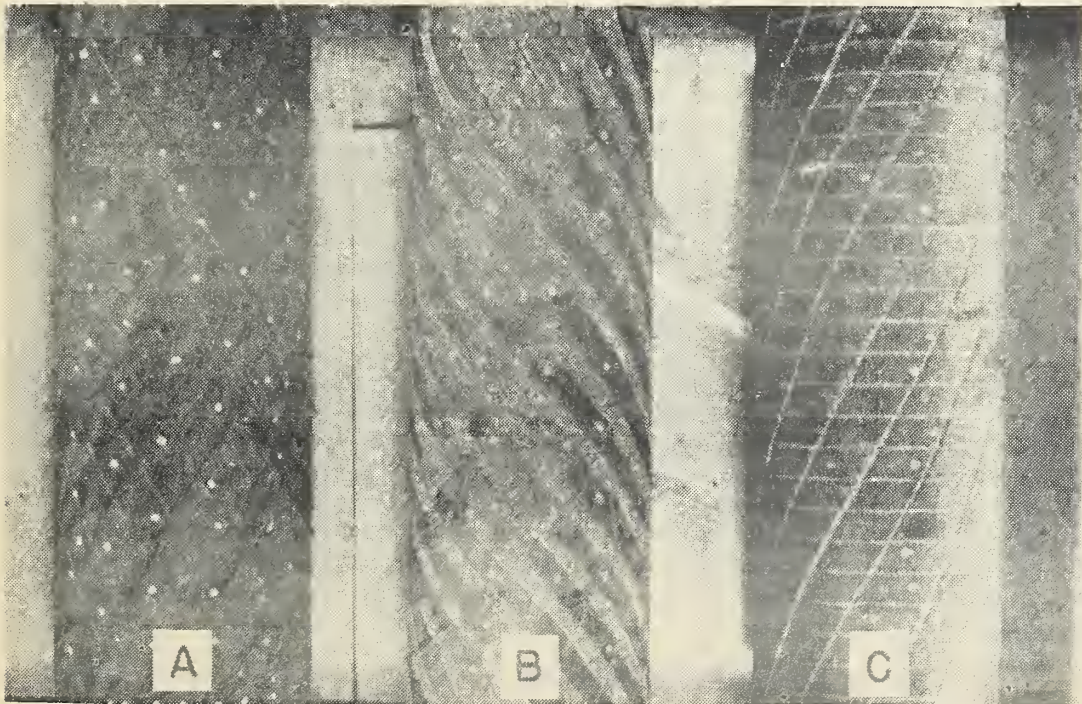


FIGURE 5.-Sections of gin rollers covered with (A) walrus only, (B) walrus and packing, and (C) packing only.

be dressed so that it will lay close to another strip. After this side is straightened out, the strip is reversed so that the belly side is up. This side is soft and fairly smooth but a light cut is necessary to clean off the dirt and decayed places. A slight bevel is made on this side so that the strips will come together on the roller.

The roller is laid off for the first strip by driving a small nail part way in at each end of the roller. A string is tied to one nail and passed around the roller to the other nail, making one complete turn. A line is then drawn along the string and the string is removed. This line is the position of the first strip. A 1-inch glue brush is used to paint a band of glue along the line for the first strip and to apply glue for succeeding strips. A strip of walrus is started by driving a 6-d common nail through the end of the strip at the end of the roller, stretching the strip along the line until it reaches the other end of the roller, and fastening it with another nail, then starting at the first end and driving a nail every 3 inches along the strip. The next operation is to start both the walrus and rubber together, placing the rubber strip between the walrus strip which is already fastened on the roller and the next strip. Both rubber and walrus are then pressed tightly together and nailed to the stock, then the walrus is stretched tightly along side the other strip and both rubber and walrus are nailed like the first strip. The strips should be pressed closely together and the nails should be staggered. This operation is continued until the roller is completely covered. The roller is then allowed to set for 24 hours so that the glue may dry, after which the nails are removed and hardwood pegs are driven in the same holes. The roller is then turned down true in a lathe. Sections of the completed rollers are shown in figure 5.

When gin rollers are covered with walrus, the hard side of each strip should face in the same direction. The roller should be placed in the lathe so that the cutting tool will strike the hard side first; this will lay the fibers on the leather in the same direction and away from the hard side. The roller should be mounted in the gin so that when it is in operation the edge of the fixed knife will strike the hard side first. In this position, the fibers on the leather will remain in the same position as they were when the roller was turned off. When the above directions are followed, the roller is easier to "break in", will last longer, and give less trouble from picked-out places on the soft side of the strips.

The procedure in putting on an all-packing covering varies in that it can be wound on in a continuous strip. (Figure 5-C.) The starting end must be tapered and then anchored with a nail, after which the roller can be turned and the packing placed on it in a tight spiral until the other end of the roller is reached. Glueing and pegging is done in a manner similar to the walrus procedure. In all cases, care must be observed to get glue only on the roller side and not up between the strips, because as the roller wears down this glue will become exposed and interfere with ginning.

All gin rollers should be grooved to prevent moths or small defective seed from hanging under the fixed knife which often cause crimping or breaking of fibers. These grooves are v-shaped, about 1/8 inch wide and 3/16-inch deep, and should be spaced about 2 or 2-1/2 inches apart. The direction of the grooves is diagonal and opposite to the direction of the covering strips. In the case of a 40-inch roller where the covering strips

make one turn in the length of the roller, the groove should make one turn in the opposite direction. On an all-packing covering, the direction of the groove spiral is immaterial because the packing is put on almost parallel to the direction of rotation. The grooves should never be allowed to close, and must be cleaned and deepened as the roller wears down.

DOFFER CONSTRUCTION AND INSTALLATION

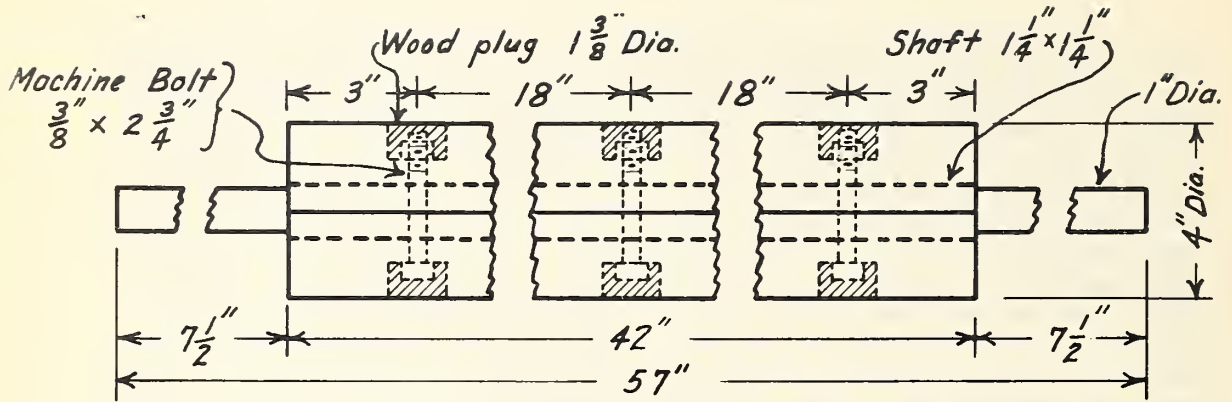
An attachment has been developed, in the form of a revolving cylindrical doffer, for use with roller gins. It improves operation by assuring that lint will not pass around the roller and cause back lash and it tends to give the ginned lint a smoother appearance. When a composition covering is used on a roller it is almost essential to have a revolving doffer working in connection with it. However, in areas where static electricity is prevalent, the performance of the doffer is not satisfactory unless means of reducing or eliminating static is provided. The original public patent 3/, granted to the Department in 1924, called for rubber flaps and operation at a high speed. It was re-designed with metal construction at the laboratory in 1935, and tried out experimentally with American upland cottons. Its value was still more apparent for improving grade when taken to Arizona and used in connection with a suction condenser that carried the cotton directly to the press, thereby eliminating dust and fly in the gin house. Although this arrangement worked very satisfactorily, it was considered relatively expensive and ginners did not feel justified in using it under prevailing conditions. An inexpensive, low-speed doffer, tried with sea-island cotton in 1938, was found to be satisfactory and its use should be quite widespread during the 1940 season. The doffer wipes the roller clean and tends to eliminate the "kinks" that the roller gin puts in the fibers. This curl or kink is largely responsible for the rough, lumpy appearance of roller-ginned cotton, and the doffer, by reducing it to a great extent, makes the lint appear more like saw-ginned lint.

The low-speed doffer is of very simple construction. Parts necessary for one and the method of assembling these parts are shown in figure 6. An old roller stock should be used if one is available, rather than to make up a new one. The flaps or fins can be cut from an old automobile inner tube and tacked down so they overlap as shown in the diagram. The doffer is mounted behind the roller, as illustrated, and driven from the gin roller shaft. Its surface speed is slightly greater than that of the cotton bat so that there will be a tendency to straighten out the fibers as it pulls them from the roller.

SETTING AND ADJUSTING ROLLER GINS FOR EFFICIENT OPERATION

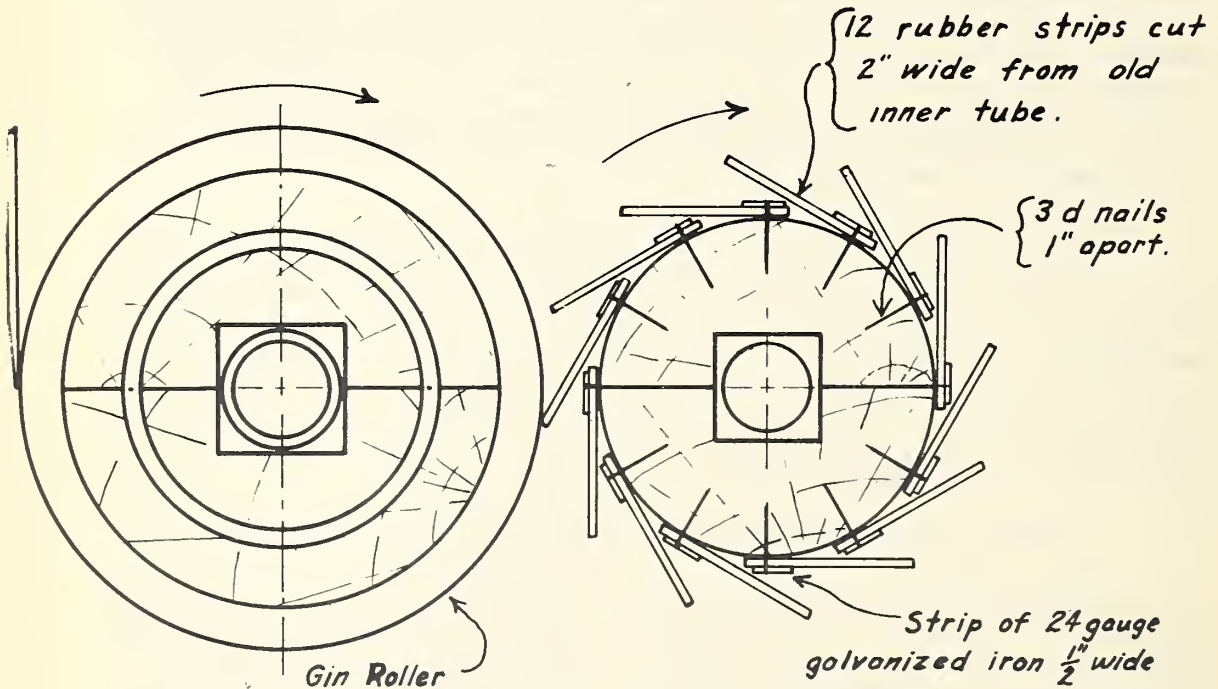
Practically all gins have, or will develop with age, certain peculiarities of adjustment and operation. Experience with these various elements will enable the ginner to keep gins operating at their best as far as capacity and performance is concerned. The following procedures deal with setting the 40-inch single-roller and the 60-inch double-roller gins and cover in a general way the factors which are to be encountered in adjusting these gins.

3/ Townsend, James S., Attachments for Roller Cotton Gins, Public Patent granted, July 29, 1924.



SIDE VIEW

Scale : 3" = 1'



END VIEW

Scale : 6" = 1'

FIGURE 6.-Drawing of parts and assembly of the roller gin doffer.

On the 40-inch roller gin, the fixed knife should extend beyond the ends of the roller, so that the roller will wear true from end to end. When the knife is shorter than the roller it will be cut into the leather and leave a ridge on the ends of the roller. If these ridges are not trimmed off every week, the roller will wear unevenly and the ends will be larger than the middle.

On most roller gins the fixed knife is set at the center of the roller and in line with the top cross rail, which is perpendicular. A number of clamps in some gins hold the knife against the roller and the pressure is maintained by tightening the clamps or by pulling the roller forward against the knife. As it is necessary for the knife to remain in this position and at the same time to have the proper pressure against the roller, it is difficult to maintain the proper relation between the two without constant adjustment. Uneven adjustment of the clamps causes the roller to wear unevenly. This feature of adjustment can be greatly simplified by removing the clamps and replacing them with a single bar of quarter-inch steel 3 inches wide. By using the same bolts, the fixed knife is clamped against the rabbit of the top cross rail with the straight side against the roller.

The desired pressure of the roller against the knife is then obtained by adjusting the roller boxes. Care must be taken to adjust both ends so as to have equal pressure on the whole length of the roller, and thus enable the ginned cotton to come over the roller evenly and the roller to wear true from end to end. By eliminating the small clamps and giving the knife a fixed-centered relation to the roller, there is no chance of mis-setting the knife, and all of the gin stands can be given the same adjustment, which is essential to the uniform ginning and appearance of the lint. The pressure of the fixed knife on the roller should be just enough to pull the cotton over in a continuous sheet at a steady rate. Too much pressure will generate extreme heat, produce excessive wear on the roller, and cause the fiber to curl or crumple, thereby giving the cotton a rough appearance. Samples of such cotton also are likely to appear somewhat darker in color on account of the shadows that are cast by the rough, uneven surface.

Overlap of the moving knife should be at least $\frac{3}{4}$ of an inch when the staple length is $1\frac{5}{8}$ to $1\frac{11}{16}$ inches $\frac{4}{8}$. When the overlap of the moving knife is too short, more strokes of the knife are required to separate the seed from the lint. In the meantime, more cotton may be accumulating under the fixed knife, and a thick sheet may be formed which comes over the roller in a badly crimped or rough condition. With a longer overlap of the moving knife, the cotton goes through more quickly, and, since there is less accumulation of cotton under the knife, the fiber comes over the roller in a thinner sheet and gives a much smoother appearance. When the moving knife has only a short overlap, the upper surface of the bat of cotton coming over the roller usually is much smoother than the surface that lies against the roller, the roughness of the sheet of fiber being due to the accumulation and crumpling that occurs. The overlap adjustment on the single roller gin is made by changing the length of the crank legs.

In Georgia and Florida, where double-roller gins are used more than the single type, most of the ginners seem to prefer this gin because it has extra roller space incorporated in one unit and driven with one belt. The spring arrangement on this gin also allows a quicker adjustment of the overlap which may be necessary on account of the difference in the length of the staple, a difference often occurring during the season's operation. To offset these advantages, however, there are some disadvantages and objectionable features; for example, when this gin backlashes the knife may be knocked out of adjustment, thus causing poor ginning and loss of time. Also, although one double-roller gin is equal to three of the single type, if either side or any part gets out of commission, the whole gin must be stopped, whereas with the single-roller gins, when one is disabled the others can still be operated.

In order that a double-roller gin may be readily adjusted, the parts should be set as close to their final positions as possible before they are bolted. The fixed knives must be set so that they can be raised or lowered when necessary, and it is highly important that sufficient pressure be exerted by the springs on the top cross rail to keep the knife in the same position after it is adjusted. The springs must be stiff enough to withstand the blow of the moving knife when it knocks the seed from the fiber as it is held between the fixed knife and the roller, because if the knife is moved up, the overlap will be shortened and the gin will not freely take the cotton over the roller. Also, a constant accumulation of lint under the knife will cause backlashing, as previously pointed out.

The roller, like the fixed knife, should be set so that it can be raised or lowered and so that the bevel on the fixed knife will rest on the roller from the heel to the edge. One of the best ways to check this bearing is to turn the rollers over in the morning after the knives have been pressing on the roller during the night. The impression of the knife on the surface of the roller is clearly marked and it will be $3/8$ -inch to $1/2$ -inch wide when the gin is set properly.

The moving knives must be set so that the knives on both sides of the gin rise the same distance above the lower edges of the fixed knives; this overlap should be about $3/4$ -inch before adjustment. The adjusting screws on the ends of the gin can then be used to raise or lower the fixed knives and rollers in order to increase or decrease the overlap; that is often necessary as the staple of the seed cotton may vary as much as a quarter of an inch in length on the same variety. When manipulating these adjusting screws, however, both the knife and roller should be adjusted together or the knife may be raised too high above the center of the roller and so may cut the covering too rapidly; or the knife may go too far below the center of the roller and cut or break the seed.

All roller gins, whether new or reconditioned, require close attention in their operation. Frequent inspection and adjustment of their vital parts have to be made to insure smooth operation, efficient performance, and good quality lint. Gin capacity depends on the proper adjustment of the knives, the speeds of the roller and crank, and the distribution of the seed cotton over the length of the roller. New gins should be thoroughly checked before they are put in operation. Old gins periodically require a complete overhauling by mechanics experienced in the art of making rollers and adjusting the gins to perform efficiently.

